

4300 ft. (4) J. D. Schoeller and R. S. Campbell's no. 503 (Forest Service no. 51402). Collected February 1, 1926, at 4300 ft. Associated with tobosa and burrograss.—W. A. DAYTON, Forest Service, Washington, D. C.

THE ASTER NOVAE-ANGLIAE, ASTER AMETHYSTINUS, ASTER MULTIFLORUS COMPLEX

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In 1841,¹ Nuttall described and named *Aster amethystinus* from certain specimens found "in Massachusetts, near Cambridge and Salem, rare." This species was indicated as a "well marked and ornamental species, somewhat allied to *A. graveolens*, intimately to *A. novae-angliae*, but from which it is entirely distinct, the flowers not half the size, pale blue, very numerous, and disposed in a panicle, etc."

Suspicion of the possible hybrid nature of *A. amethystinus* was finally crystallized by Benke² in 1930. He epitomized the situation as follows, "The presence in close proximity of the two species before mentioned"—*A. novae-angliae* L. and *A. multiflorus* Ait.³—"in each case observed and the striking intermediate characteristics of the plant between the two furnish added circumstantial evidence that this charming aster may, with good reason, be regarded as a hybrid."

Later in the same year, Knowlton⁴ mentioned his experiences with this species in northwestern Massachusetts and southwestern Vermont, the site of Eggleston's original report of this species for Vermont. Here again he found both parents scattered around in "considerable profusion." His concluding sentence was pointed, "It would be a very interesting project for some botanical garden or experiment station to breed this interesting hybrid artificially for comparison with wild plants."

Further comments⁵ on the presumed hybrid nature of this species of *Aster* have been forthcoming from time to time. An examination of

¹ Trans. Am. Phil. Soc., ser. 2, 7: 294. 1841.

² RHODORA 32: 1-3. 1930.

³ The name *A. multiflorus* Ait. is used here because of its general occurrence in Gray's Manual, 7th ed., and other floras, instead of *A. ericoides* L. which, as Mackenzie and Blake point out, antedates it and under which the original description was made. Mackenzie, K. K. RHODORA 28: 65. 1926. Blake, S. F. RHODORA 32: 136-140. 1930.

⁴ RHODORA 32: 185-186. 1930.

⁵ Professor A. J. Eames reported to the senior author in a personal communication that he had produced *Aster amethystinus*-like plants experimentally by pollinating *A. multiflorus* stigmas with pollen from *A. novae-angliae*. He indicated that plants representing this cross are now in the herbarium at Cornell University.

the specimens found under this designation in the herbaria of the New England Botanical Club and in the Gray Herbarium brings out strikingly two points, (1) that the plants do combine the characters of the supposed parents, and (2) that they do so in every conceivable combination so that an almost graded series can be made from *A. novae-angliae*-like plants to those like *A. multiflorus*.

In the course of field, greenhouse and laboratory study of the genera Aster and Solidago, the senior author chose this species for genetical study in the hope of understanding something of the polymorphy present. The results of this work are appearing in considerable detail elsewhere.¹ The genetical work has been carried out by the junior author. Plants typifying the parents, crosses, backcrosses, etc. have been transplanted to the Harvard Botanic Garden, Cambridge. Pressed specimens have been placed in the Gray Herbarium.

The results of these studies may be summarized as follows:—

1. The two supposed parents, *A. novae-angliae* and *A. multiflorus* are self-sterile and reciprocally interfertile.
2. The F_1 hybrids are intermediate between the two parents and phenotypically rather uniform.
3. These F_1 plants are interfertile, providing a high percent of viable seed.
4. The F_2 population resulting is exceedingly variable, the characters studied not lending themselves to simple Mendelian analysis.
5. The backcrosses of the F_1 hybrids with the two parents give progenies which exhibit a polymorphy grading from the F_1 's to either parent.
6. A comparison of the forms produced in these genetic studies with those found in the collections of the Gray Herbarium and the Herbarium of the New England Botanical Club indicates that the natural variants can be matched with those genetically produced and that a preponderance of those obtained from Nature can be designated as backcrosses.
7. Utilizing a method suggested by Anderson² by which qualitative characters are converted into quantitative numerical values, statistical confirmation is provided for the above interpretation of this inter-specific variation.
8. Studies of chromosome numbers and chromosome morphology

¹ Wetmore, R. H. and A. L. Delisle, Am. Jour. Bot. 26: 1939.

² Ann. Missouri Bot. Garden. 23: 511-525. 1936.

in the parents, the F_1 's and the F_2 's and the backcrosses of known genetic origin give added support to the above interpretations.

9. A plotting of the distribution of the specimens of the two parents and of those interpreted as *A. amethystinus* Nutt. found in the Gray Herbarium indicates that both parents are found in the regions from which the hybrids have been reported.

The authors therefore confirm earlier opinions that *A. amethystinus* Nutt. includes forms which originated initially from crosses between *A. novae-angliae* L. and *A. multiflorus* Ait. Reports of plants belonging to the *A. amethystinus* complex have been infrequent. Obviously the parents must be reasonably close together if cross pollinations are to occur and F_1 's be produced. The laws of chance are, however, against F_1 's appearing very often in close geographical relation to one another. In consequence, it is likely that F_2 's would be even more rarely produced. However, since F_1 's ordinarily occur in proximity to one or both parents, backcrosses might be expected from time to time in the haphazard pollinations by insects. It is significant therefore that the variability of known genetic backcrosses in this complex accords in extent and in pattern with the forms collected in Nature.

The authors suggest therefore that, in highly polymorphic genera such as Aster and Solidago,¹ fortuitous hybridization followed by backcrossing must be considered as a possible contributing factor to interspecific variation.

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¹ Goodwin, R. H. RHODORA 38: 22-28, 1937.
——— Am. Jour. Bot. 24: 425-432, 1937.